

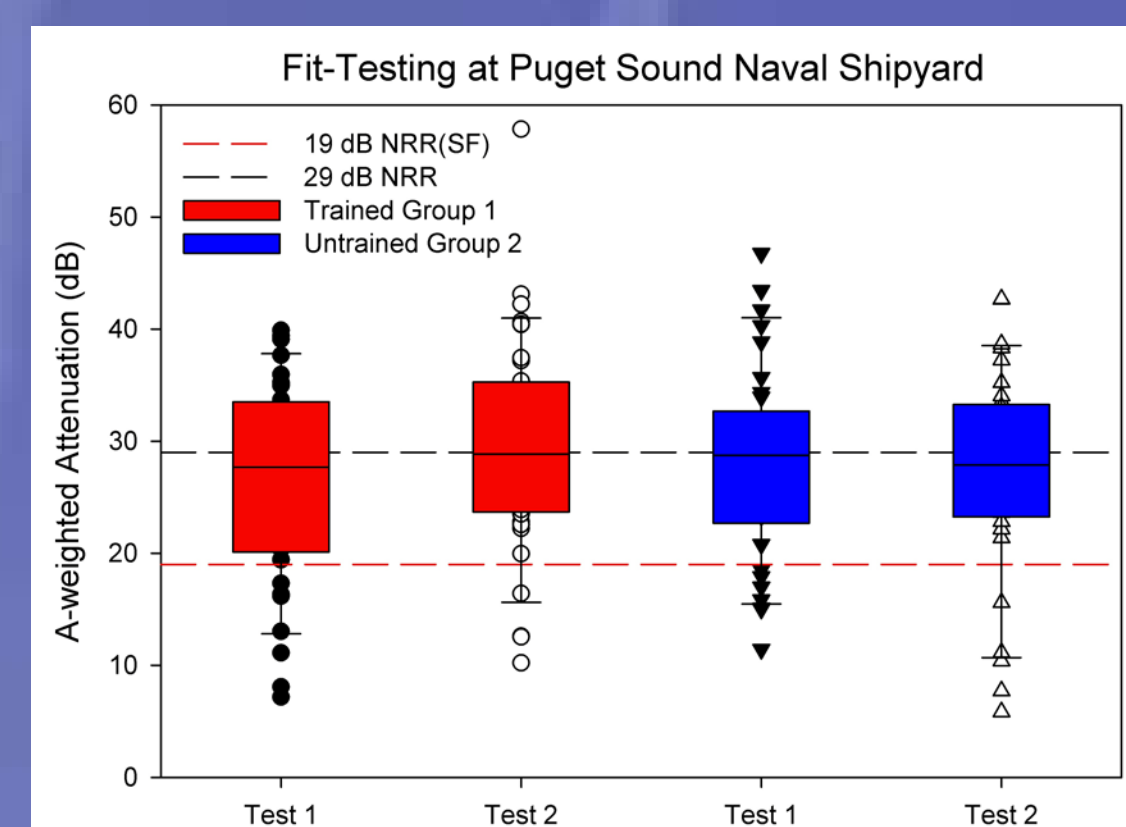
# Application of the NIOSH HPD WellFit System

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## Introduction

The use of fit-testing to determine individual attenuation of hearing protection devices (HPDs), while not required, is emerging as a “best practice” in hearing loss prevention programs. The National Institute for Occupational Safety and Health (NIOSH) recently collaborated with the Puget Sound Navy Shipyard to investigate methods for improving HPD performance in the real world. Results of this effort indicated that workers were generally obtaining satisfactory attenuation from their HPDs.



However, fit-testing HPDs proved to be time consuming. Thus it was not feasible to employ fit-testing in an iterative procedure in order to improve HPD performance. As a result, NIOSH has developed HPD WellFit™. This system for fit-testing HPDs accurately measures individual attenuation and provides a metric showing how this value compares to labeled performance. Additionally, the process is extremely quick (~7 minutes, or less). Because of the speed with which attenuation can accurately be measured, the HPD WellFit™ will enable workers to “train to mastery” in how to fit earplugs.



## Problems to be Addressed

- Unlike respirators, there is no standardized process for determining if an individual worker can properly fit his/her hearing protector.
- Failure to properly fit and wear hearing protectors has been cited as the leading cause of occupational hearing loss.
- Commercially available hearing protection fit-test systems have limitations which limit their general application:
  - May require expensive instrumentation,
  - Work only with selected proprietary protectors,
  - Require a substantial amount of training and time to evaluate protector fit.

**Disclaimer:** The findings and conclusions in this poster have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

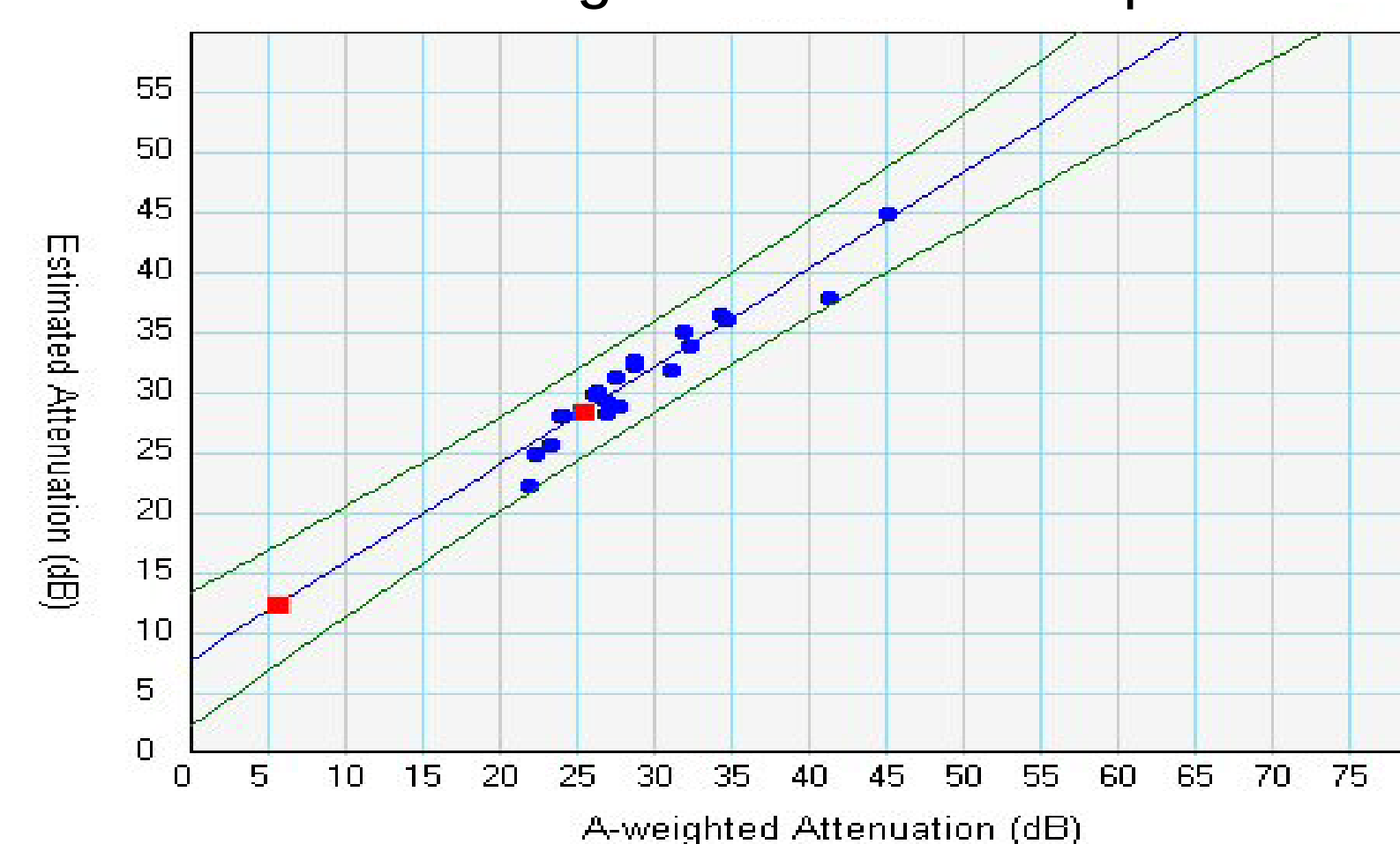
## System Components

- Computer-based Real-Ear Attenuation at Threshold under headphones
- 24-bit Digital Audio
- Attenuation through manipulation of WAV output amplitude
- Sound Isolation headphones 100–10,000 Hz
- Mouse with scroll wheel
- Estimated cost: ~\$2,500 including computer

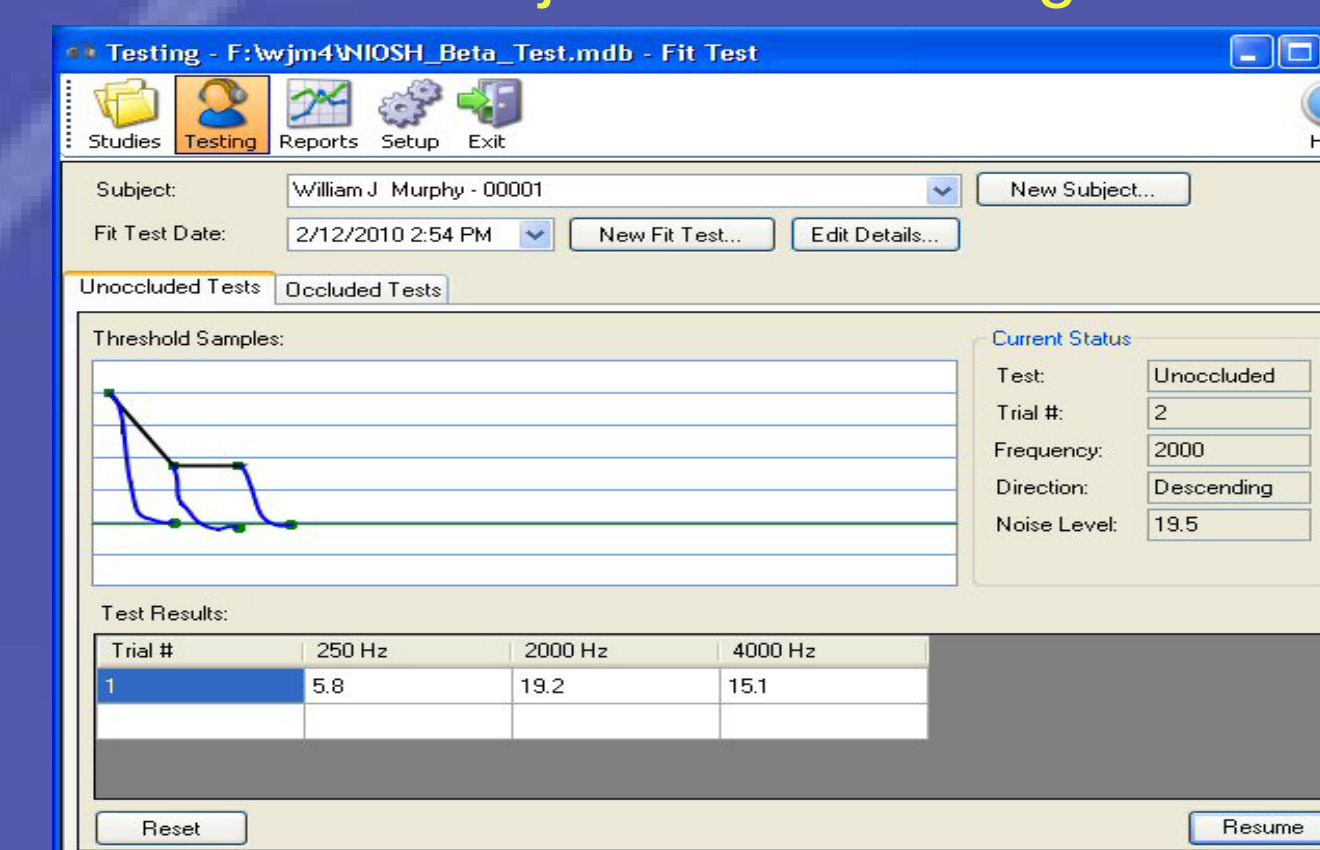
## Tester/User Training

- HPD Well-Fit is meant to be integrated with a comprehensive Hearing Conservation Program
- NIOSH earplug training videos will be integral with future versions
- Testing method uses familiar modality
- Users rapidly understand the method
- Testers immediately see how the user progresses

## Linear Regression Curve Report



## Method of Adjustment Testing Screen

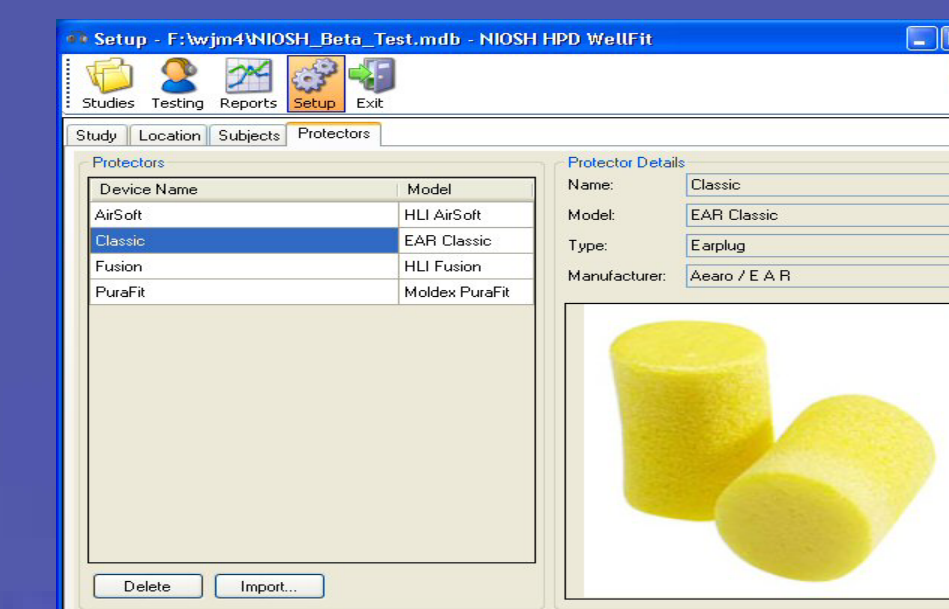


## Testing Paradigm

- Testing Methods are configurable
  - ◆ Method of Adjustment (scroll and click)
  - ◆ Modified Bekesy (re ANSI S12.6-2008)
  - ◆ Hughson-Westlake (planned 2010)
- Binaural testing (monaural planned)
- Tests can be completed in less than 3 minutes; add 2 minutes for foam plugs to expand.
- Training/Retesting requires about 8 minutes.

## Attenuation Rating

- HPD Well-Fit estimates an A-weighted attenuation.
- A subset of frequencies are tested.
- Linear regression is computed from manufacturer data.
- Overall attenuation is estimated from regression
- More frequencies increases accuracy of rating.
- Lower Prediction Interval is the reported rating.
- Rating is added to 85 dBA to estimate allowable noise exposure



## Future Research

- Laboratory investigations will assess acoustic variables and psychoacoustic parameters:
  - Transfer function between unoccluded pure-tone vs. 1/3 octave-band test stimuli
  - Optimal psychophysical method for determining auditory thresholds
- Data will be provided to ANSI S12 committee for noise, Working Group 11, to develop an evidence-based field attenuation measurement standard (fit-testing) for HPDs.
- Authoritative guidance for fit-testing HPDs will be developed for the next revision of the NIOSH Criteria Document on Occupational Noise Exposure.

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